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JOHN W. FINCH, DIRECTOR

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THE USE OF TREATED MINE TIES AND TIMBERS IN ILLINOIS AND INDIANA COAL MINES

BY

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THE USE OF TREATED MINE TIES AND TIMBERS IN ILLINOIS AND INDIANA COAL MINES[1]

By C. A. Herbert[2]

Timber decay is due largely if not wholly to a fungus growth on the timber from which it derives food; a warm, moist atmosphere is necessary for rapid growth. The decay is spread from infected timber to sound timber by countless microscopic spores or seeds given off by the fungus growth and carried by air currents or by long, cottonlike threads, which spread from timber to timber.

Haulage roads in most mines in the central coal fields are also return aircourses; hence moisture and temperature conditions are ideal for the rapid decay of mine ties and mine timber. Possibly the return air, which contains a higher percentage of carbon dioxide than normal outside air, also stimulates the growth of fungi. Those familiar with coal mining have observed the more pronounced growth of fungi and decay of timber in poorly ventilated worked-out sections of mines where the air is moist and where usually the percentage of carbon dioxide in the air is considerably above normal.

Decay of timber is prevented or at least very much retarded by impregnation with some substance poisonous to fungi, which prevents or greatly retards the development or growth of the spores or seeds.

The two substances most commonly used in this country for treating timber are creosote oil and zinc chloride; each has certain advantages and disadvantages. Creosote oil undoubtedly is more toxic to fungus growth than zinc chloride, is not water-soluble, and consequently does not leach out of the timber when subjected to moisture, as zinc chloride does. Freshly treated creosoted timber probably is more inflammable than untreated timber or timber treated with zinc chloride and is also more expensive than the latter.

Creosote irritates the skin, and many workmen therefore object to handling creosoted timber. This objection, however, is largely overcome by removing the surplus creosote at the time of treatment and then stacking the treated timber in open storage piles long enough to allow the volatile oil on the outside of the timber to dry off or escape before use. After treated

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timber has been thus stacked it is little if any more inflammable than untreated sound timber and much less inflammable than untreated decayed timber.

Zinc chloride, although not as toxic as creosote, gives good results, particularly where there is not enough moisture to cause leaching of the salt. It does not irritate the skin, is thought to be slightly fire-resistant, does not discolor the wood, and may be used where the wood is to be painted, as in surface buildings.

The most satisfactory and ultimately the cheapest method of applying these preservatives is by pressure, the only method that affords uniform and maximum penetration.

Several mining companies in Illinois and Indiana are using treated mine ties and some are using both treated ties and mine timbers with satisfactory results. Although treated material has not been used in this field long enough to determine the added life, the service records in certain mines in the anthracite field of Pennsylvania indicate that an average life of approximately 20 years may be expected.

Railroads are the largest users of treated wood in this country; some of them date all ties and timber when installed and keep a service record of both treated and untreated material extending over many years; thus definite information is available by which the enormous economic value of wood-preservative treatment is revealed.

Unfortunately the mining companies in the Illinois and Indiana field using treated ties and timber did not date them at the time of installation and have made no effort to keep service records similar to those kept by the railroad companies; however, they do know in general the replacements necessary in sections of track laid on known dates where both treated and untreated ties were used and in other sections where only treated ones were used. They also know the number of replacements of untreated timbers set next to treated timbers that are still sound; the evidence is conclusively in favor of treated mine ties and timber where a life of more than 2 years is desired.

As far as could be learned there are only two mines in the central coal field where ties are treated by dipping in hot creosote oil in open tanks; in neither has the treated material been in service long enough to determine the average life of the timber so processed.

Other mines using treated material are purchasing ties and timber treated with zinc chloride (half a pound of salt per cubic foot of timber) by the pressure method in commercial treating plants. One mine, however, claimed that the chloride leached out of the ties and timber and did not give nearly as good results as creosote; consequently it is now buying creosoted material.

At one mine creosoted ties installed at the shaft bottom at the time of development about 15 years ago are still in service, with no replacements due to decay; apparently they will give several years of additional

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service. At another mine track laid with treated ties 10 years ago is still in service. At still another treated wooden legs and collars have been in service 7 years, whereas nearly all untreated legs and collars failed in less than 2 years.

White-oak ties apparently have a longer life than those of other hardwoods, and yet untreated they seldom last over 2 years. Untreated ties from some of the cheaper hardwoods sometimes fail in 8 to 10 months, but treated ties of the cheaper mixed hardwoods appear to give almost as good service as the more expensive kinds; gumwood is the most favored because of its greater resistance to mechanical wear. Treated pine ties have not proved as satisfactory as hardwood ties because of the lower resistance to mechanical wear. Following the derailment of cars or locomotives, pine ties are usually badly cut and splintered from the wheel flanges, while ties of hard or tough woods are not damaged greatly.

The depth of penetration of the preservative varies greatly with different woods and processes; in most instances it is largely confined to the sapwood, with little penetration of the denser heartwood. Therefore, to obtain the maximum service from treated ties the mine rails must be large enough to prevent them from cutting into the ties and breaking through the impregnation, as decay will follow in the exposed and untreated wood. The same may also be said of mine timber, which if possible should be cut to size and framed before treatment; if it cannot be cut and framed the unimpregnated parts of the timber exposed by cutting and fitting into place should be given several brush coatings of preservative before the timber is placed and possibly afterward also; otherwise these parts will likely decay and the results from using treated timber may be disappointing.

The consensus of opinion as regards treated ties is in favor of sawed ties; they are easier to lay and much easier to renew than hewn ties and at the same time give a much better bearing surface for the rails. Hewn ties must often be trimmed to give proper bearing for the rails; if they have been treated the trimming is likely to ruin the value of the treatment.

The estimated life of untreated ties was found to range at different mines from 1 to 3 years; doubtless an average life of 2 years would be conservative. Although no service records are available in Illinois or Indiana from which to determine the average life of treated mine ties, in one mine treated ties have been in service for 15 years without replacement due to decay and show every indication of giving many years of additional service. In another mine treated ties have been in continual service for 10 years and appear to be good for several more years of service. An estimated average life of 15 years would seem to be conservative in view of the fact that treated timber has been in continuous service for a quarter of a century in certain Pennsylvania anthracite mines.

Many of the mines in this field are now "timbering" the main haulage entries with steel railroad rails or steel I-beams hitched into the ribs. Where wooden timber is used and the life of the places timbered will exceed

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the probable life of the untreated timber (in most instances, about 2 years), unquestionably treated timber is more economical.

An advantage in the use of both treated ties and timber which will offset the cost of treatment is that in most instances lighter material can be used; as a rule heavier timber than actually needed to support the load is used to compensate for the weakening of the timber by decay.

The price of treated ties and timber naturally varies somewhat at the different mines because of differences in freight rates between the mines and the treating plants and the difference in the specifications of the material used. The average price at the mine of treated main-line ties is about 55 cents, whereas untreated ties of the same size cost approximately 30 cents. Treated room ties average about 30 cents delivered and untreated room ties, about 22 cents delivered.

The estimated cost per tie in place for first laying and for renewals varies for different mines according to conditions. The average cost of main-line ties, however, is approximately as follows:

First laying

Untreated tie.....	$0.30	Treated tie.....	$0.55
Delivery inside....	.03	Delivery inside..	.03
Laying and spiking	.25	Laying and spiking	.25
Cost in place	$0.58	Cost in place	$0.83

Replacement

Untreated tie.....	$0.30	Treated tie.....	$0.55
Delivery inside....	.03	Delivery inside...	.03
Removing old tie, laying and spiking new tie	.65	Removing old tie, laying and spiking new tie	.65
	$0.98		$1.23

If the life of an untreated tie is assumed to be 2 years and a treated tie 15 years, 7 replacements of an untreated tie would be necessary during the life of a treated one.

If untreated ties are used, the total cost per tie in 15 years exclusive of interest charges would be $0.58 (first cost of laying) plus 7 times $0.98 (replacement cost) or $0.58 plus $6.86 or $7.44. Whereas with treated ties the total cost during the 15 years would be the cost of first laying or $0.83, a saving per tie during the 15 years of $6.61 or a yearly saving per tie of $0.44; with ties on 18-inch centers 3,520 would be required per mile, which would give a yearly saving of over $1,500 per mile of track.

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Although the above figures indicate the direct savings that might result from the use of treated instead of untreated ties, they do not represent the total savings; most of the officials at the mines visited called attention to the indirect savings that had been made because of fewer wrecks, accidents, and haulage delays from spreading rails due to decayed ties.

Treated legs and collars used in entry timbering cost approximately three times as much delivered at the mine as untreated ones of the same size. This difference in price may be reduced somewhat by the use of lighter timbers than could ordinarily be used if they were untreated. In spite of this difference in first cost, treated timber will pay if the life of the place to be timbered will exceed 2 years (probable life of untreated timber). For example, in a mine where timber sets are composed of two 6-feet 6-inch legs and a 12-foot collar the cost of the untreated and treated sets in place will be approximately as follows:

Untreated timber	$1.00	Treated timber	$3.00
Delivery inside	.20	Delivery inside	.20
Labor setting	2.00	Labor setting	2.00
Total cost in place...	$3.20	Total cost in place.	$5.20

If the desired life of the set of timber is as much as 15 years (assumed life of treated timber), 7 replacements of untreated timber, in addition to the original setting, will be necessary compared with 1 setting of treated timber. In the above assumption the cost per set for untreated timber would be at least 8x$3.20=$25.60 compared with $5.20 for treated timber.

In addition to direct saving, there will also be considerable indirect saving due to greater safety and fewer delays caused by failure of entry timber; these savings cannot be given in dollars and cents, but unquestionably many accidents occur in the replacing of decayed or decaying timbers. In all probability several accidents would occur in 8 replacements of timber, and such accidents are likely to be serious.

One Illinois operator who uses both treated and untreated timber has saved considerable by having all his untreated timber peeled in the woods before shipment, as peeled untreated timber is found to have nearly twice the life of unpeeled untreated timber. The cost of peeling is not excessive and is nearly covered by decreased freight charges.

CONCLUSIONS

Where the desired life of ties, timber, or other material as lagging and cap pieces exceeds the probable life of the untreated material, which in most instances is not over 2 years, a distinct saving in material and labor may be expected by preservative treatment, as well as indirect savings resulting from greater safety and efficiency of operation.

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All treated material should be marked with a dated nail giving year of installation, and a service record should be kept in order that the coal operator may have definite knowledge as to the comparative value of different kinds of timber and different kinds of preservative.

With the information available on the value of preservative treatment of wood for surface and underground uses, it is difficult to understand why more mine operators have not availed themselves of this opportunity to effect a saving in operating costs and simultaneously establish conditions likely to bring about reduced accident occurrence in haulage and roof falls.

For additional information on the subject, the operator is referred to:

Service Bureau, American Wood Preservers' Association,
111 West Washington Street,
Chicago, Ill.

United States Forest Products Laboratory,
Madison, Wis.

Bulletin 235,
U. S. Bureau of Mines,
Washington, D.C.

Bulletin 33,
Carnegie Institute of Technology,
Pittsburgh, Pa.

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